TOXIC PNEUMONITIS IS ASSOCIATED WITH DRY COUGH AMONG RECYCLING WORKERS

T.Sigsgaard
STENO Institute of Public Health,
Dept of Environmental & Occupational Medicine,
University of Aarhus, Denmark.

Abstract

A high prevalence of toxic pneumonitis (TP) among recycling workers in Denmark have been reported earlier. This study investigates the relationship between TP and other respiratory among exposed recycling workers. Thirty-eight garbage-handling workers (GHW) and 150 paper-workers (PW) at a paper mill producing recycled paper were examined with a questionnaire covering respiratory symptoms, allergy, smoking and work history. The diagnose of TP was made if the persons had experienced two or more of the following symptoms: fever, influenza feeling or chest tightness in relation to their work. Chronic dry cough was diagnosed if the person had had cough without phlegm for at least 3 months a year for at least 2 years. The prevalences of dry cough were 21% and 6% among GHW and PW respectively. The prevalences of TP in the groups were 16% and 17%. In a multiple logistic regression analysis controlling for smoking, Odds ratio (OR) for dry cough was significantly increased among persons who had experienced TP, whereas the OR was decreasing with length of tenure. In conclusion this study shows a significantly increased OR for dry cough among persons who have experienced TP associated to their work. This could reflect an increased susceptibility among these persons leading to different symptoms after exposure to organic dust.

Introduction

Organic dust is known to induce a range of adverse effects on the exposed workers. These effects include diseases as asthma, chronic bronchitis and allergic alveolitis(1-3), but also more mild reactions as MMI, rhinitis and ODTS or toxic pneumonitis(4) are observed among workers exposed to organic dusts(5).

One follow up study has indicated an association between toxic pneumonitis and onset of occupational asthma (6), However, this finding has not been reproduced in later studies.

High prevalences of toxic pneumonitis (TP) have been reported among recycling workers in Denmark (7,8). This study investigates other respiratory symptoms among these exposed workers as risk factors for toxic pneumonitis.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:189-192 (1997)
National Cotton Council, Memphis TN

Materials and Methods

Material

The populations in the study have been described earlier, and will only be discussed briefly here.

From a survey of the Danish waste recovery industry 38 garbage handling workers were selected (7). From another study of paper recycling workers 150 persons were included.(8)

Pulmonary Function Testing

Pulmonary function was tested in each worker using a dry spirometer (Vitalograph, Buckingham, UK.). Forced expiratory volume in first sec (FEV_1) and forced vital capacity (FVC) were measured. The testing was performed in accordance with the methods of the American Thoracic Society (9). The procedure was slightly modified and the better of two well-performed trials was chosen, if the subject performed well on the first two attempts.

Predicted values of FEV_1 and FVC were calculated using the standards supplied by the Danish Society of Lung Physicians (10).

Questionnaire Surveys

The questionnaires used in these studies were based on one used earlier in the cotton industry (11).

The questions covered symptoms of cough, phlegm, chest tightness, asthma, fever wheeze, breathlessness, sneezing, itchy eyes, skin and gastrointestinal (GI) symptoms. The questions also covered any relation between symptoms and the time of the day or working week. A complete occupational and smoking history as well as a familial history of allergy was obtained.

Chronic bronchitis was diagnosed if the person had cough with phlegm for three months or more for at least two consecutive years, according to British Medical Research Council criteria (12). Persons fulfilling the same criteria without phlegm were diagnosed as having chronic dry cough. Toxic pneumonitis (ODTS) was diagnosed if the person had experienced fever or a flue like feeling in relation to work.

Asthma was diagnosed if the individual had wheezing and dyspnoea in relation to exposure to either a known allergen or to unspecific agents i.e. cold air, exercise, etc.

Atopic status was diagnosed if the person had allergic asthma, allergic rhinitis or atopic dermatitis. Allergic disposition was diagnosed if one or more of the children, siblings, parents, or grandparents had an allergic disease diagnosed by a doctor, or if the person himself had suffered from allergic asthma, rhinitis or infantile eczema.

Statistics:
Tabulation, graphical analysis, oneway analysis and t-test were carried out with SPSS statistical package (13). For categorised data, Chi^2 test or Fishers exact test were performed. Logistic regression analysis was performed using one dependent variable and one or more independent variables. Confidence intervals were calculated according to standard procedures (14).

Results

The material consisted of 38 garbage handling workers and 150 paper workers. The paper workers had significantly longer mean age and mean tenure compared with the garbage handling workers, table 1.

The study of lung function in the two groups of workers showed only minor differences. The non-smoking paper workers had significantly higher FEV_1/FVC ratio of mean (SD) 81.3 (5.8) compared to 77.7 (7.6) among the smoking paper workers. Among non-smokers, paper workers had significantly higher mean FEV_1 124.5 (15.0) compared to 109.9 (15.7) among the garbage handling workers, table 2.

For the serological parameters the only difference found was the significantly lower IgG 12.2 (2.3) KU/l among smoking paper workers compared to 13.4 (2.4) among their non-smoking colleagues.

There were no differences in the prevalence of respiratory symptoms, except for chronic dry cough, among the garbage handling workers and the paper workers. The prevalence of chronic dry cough was three-fold higher among the garbage handling workers 21% compared to 7% among the paper workers, table 4.

The logistic regression showed that toxic pneumonitis and cigarette smoking were positively associated with chronic dry cough whereas tenure was negatively associated, table 5. No effect was seen for workplace or age after controlling for the above mentioned variables.

Fig 1 shows the association between TP and chronic dry cough controlling for tenure. In contrast to the negative association between tenure and chronic dry cough there was an increased OR of 4.2(1.1 -16.7) for TP from 1-10 years of employment. The increase in OR was attenuated for workers with more than 10 years of employment to 1.9 (0.4 - 10.5). There was no effect of job-type, age, smoking and no interaction was found.

Discussion

The difference in age and length of employment between the two different job-types may be ascribed to the newness of the garbage handling industry. In Denmark there was a regulation of the garbage handling put forward by the government during the late eighties. This regulation enforces recycling and as a consequence, a lot of small recycling facilities have been created during the last few years.

The finding, that the smoking paper workers had lower mean IgG serum concentrations compared to non-smokers is probably a consequence of the immune regulation caused by components in the tobacco smoke. This is in accordance with other studies of people exposed to organic dust in the cotton industry (11,15) and the tobacco industry (16,17). Furthermore these antibodies have been shown to be associated with a decreased risk of respiratory symptoms among cotton workers (18). This might be an indication of a protective effect of IgG antibodies against the effect of these dusts.

The two types of occupation in this study are comparable for most of our variables. However, for chronic dry cough there is a marked difference. Therefore the analyses have included the type of job as a confounder. When controlling for other confounders, the effect of job type disappears. Hence, it has been left out of the final model.

In our earlier studies risk factors for TP were employment in a garbage handling process or production of paper in the recycled paper industry (7,8). We found no association to smoking or age. In this analysis we pooled all exposed male workers and analysed for other risk factors related to TP. The only other factor that was associated with TP was chronic dry cough. This symptom is probably related to the amount of dust in the working environment and the association might be a proxy for the dustiness. This seems unlikely, since this effect transcends the different occupations in the study, with a great difference in the concentrations of dust and micro-organisms. Another possibility would be recall bias i.e. the persons reporting dry cough are also reporting TP. However against that speaks the fact, that chronic dry cough only is a risk factor for TP and not other respiratory symptoms. The last possibility is, that the persons reacting towards the dust in the work-zone are the same persons that would be most prone to TP when the concentrations of dust are unusually high. The latter hypothesis is supported by the peak of toxic pneumonitis before 10 years of employment, see table 6. This is possibly an effect of healthy worker selection, like what has been described in other studies of recycling workers (19) and other workers exposed to organic dusts (20). Hence, in this case which seem the most plausible, chronic dry cough is a marker of susceptibility towards the effect of organic dusts.

Acknowledgements

This study has been made possible by grants from the Danish Work Environment Fund and The Danish Environmental Protection Agency Fund.

References

1. doPico, G. 1986. Health effects of organic dust in the farm environment. Report on diseases. *Am J Ind Med 10*:261.

2. Terho, E. O., O. P. Heinonen, and S. Lammi. 1986. Incidence of clinically confirmed farmers lung in Finland. *Am J Ind Med 10*:330.

3. Rask-Andersen, A. 1989. Allergic alveolitis in Swedish farmers. *Ups. J. Med. Sci. 94*:271.

4. Rylander, R. and P. Malmberg. 1992. Non-infectious fever: inhalation fever or toxic alveolitis? *Br J Ind Med 49 (4)*:296.

5. Rask-Andersen, A. and P. Malmberg. 1990. Organic dust toxic syndrome in Swedish farmers: symptoms, clinical findings, and exposure in 98 cases. *Am J Ind Med 17*:116.

6. May, J. J., L. H. Marvel, D. S. Pratt, and D. P. Coppolo. 1990. Organic dust toxic syndrome: a follow-up study. *Am J Ind Med 17*:111.

7. Sigsgaard, T., P. Malmros, L. Nersting, and C. Pedersen. 1994. Work related symptoms and lung function measurements among Danish refuse workers. *Am. Rev. Respir. Dis. 149*:1407.

8. Sigsgaard, T., A. Abell, and L. D. Jensen. 1994. Work related symptoms and lung function measurements in paper mill workers exposed to recycled water. *Occ. Hyg. 1*:177.

9. Becklake, M. R. 1986. Concepts of normality applied to the measurement of lung function. *The American Journal of Medicine 89*:1158.

10. Danish Society of Lung Physicians, 1986. *Lung function testing; A recommendation*. The National Society for Eradication of Lung-Diseases, Copenhagen, p. 1.

11. Sigsgaard, T., O. F. Pedersen, S. Juul, and S. Gravesen. 1992. Respiratory disorders and atopy in cotton wool and other textile mill workers in Denmark. *Am J Ind Med 22*:163.

12. British Medical Research Council, 1965. Definition and classification of chronic bronchitis for clinical and epidemiological purposes. *Lancet i*:775.

13. Norusis, M. J. /SPSS INC. 1988. *SPSS/PC+ V2.0 Base manual for the IBM PC/XT/AT and PS/2*. SPSS INC.,

14. Breslow, N. E. and N. E Day. 1980. *Statistical methods in cancer research Vol I - the analysis of case control studies IARC scientific publications no. 32*. International agency for research of cancer, Lyon,

15. Sigsgaard, T. and S. Gravesen. 1991. Molds and endotoxins isolated from the air of two Danish cotton mills, a wool mill, and a mmf mill, and the relation to serum IgG. *Proceedings. XV cotton conf,Memphis,Tennessee,1991 7*:209.

16. Andersen, P., O. F. Pedersen, B. Bach, and G. J. Bonde. 1982. Serum antibodies and immunoglobulins in smokers and nonsmokers. *Clin. exp. Immunol. 47*:467.

17. Kjaergaard, S. K., O. F. Pedersen, M. Frydenberg, H. Sch¢nheyder, P. Andersen, and G. J. Bonde. 1989. Respiratory diseases and lung function in a tobacco industry. *Archives of Environmental Health 1*:164.

18. Sigsgaard, T. and M. H. Karol. 1993. Relation of antibody titer to symptoms and exposure of Danish textile mill workers. In *Proceedings - XVIIth Cotton Dust Research Conference*. R.R. Jacobs, L.N. Domelsmith and P.J. Wakelyn, eds. Cotton Incoorporated, Memphis, p. 285.

19. Sigsgaard, T., B. Bach, and P. Malmros. 1990. Respiratory impairment among workers in a garbage-handling plant. *Am J Ind Med 1*:92.

20. Sigsgaard, T. 1992. Healthy worker selection among workers exposed to organic dust. In *Proceedings - XVIth cotton dust conference*. P.J. Wakelyn, L.N. Domelsmith and R.R. Jacobs, eds. National Cotton Council, Memphis Tn, p. 229.

Table 1. Demographic data among recycling workers. Mean (SD).

	Garbage	Paper	p t-test
Age	36.8 (11.9)	40.2 (10.3)	0.07
Tenure (months)	32.8 (63.8)	92.9 (78.6)	0.00
N =	38	150	

Table 2. Lung function data among recycling workers. Mean (SD).

	Garbage	Paper
Smokers	24	69
FEV_1	113.5	117.8
	(17.8)	(18.5)
FVC	119.2	122.0
	(15.6)	(13.5)
FEV_1/FVC*100	77.4	°77.7
	(8.1)	(7.6)
Non-smokers	12	70
FEV_1	109.9	#124.5
	(15.7)	(15.0)
FVC	113.5	123.8
	(10.6)	(15.0)
FEV_1/FVC*100	77.3	81.3
	(6.7)	(5.8)

#: p <0.05 group vs. garbage handling workers
°: p <0.05 group vs. non-smokers

Table 3. Immunoglobulins among recycling workers. Mean (SD).

	Garbage	Paper
Smokers	19	66
IgE	71.3	61.7
KU/l	(106)	(121)
IgG	12.1	°12.2
KU/l	(2.8)	(2.3)
Eosinophils	156	251
	(90)	(190)
Non-smokers	12	70
IgE	28.2	45.3
	(48)	(67)
IgG	12.5	13.4
	(3.5)	(2.4)
Eosinophils	196	212
	(148)	(158)

°: p <0.05 group vs. non-smokers

Table 4. Respiratory symptoms among recycling workers.

	Garbage %	Paper %	p Chi sq.
Hay fever	8	12	0.67
Asthma	3	7	0.57
Chest tightness	35	24	0.25
Chr dry cough	21	7	0.02
Chr bronchitis	13	8	0.50
Tox pneumonitis	16	17	1.00
N =	38	150	

Table 5. Odds ratio for chronic dry cough among recycling workers.

		OR	95% ci.
Toxic pneumonitis		5.8	1.8-18.7
Tenure (months)	13-120	0.3	0.1-0.9
	121+	0.1	0.01-1.2
Cigarettes pr day	1-10	1.8	0.3-11.6
	11+	3.9	1.1-13.9
Grand mean		0.1	0.03-0.3

Table 6. Odds ratio for toxic pneumonitis among recycling workers.

		OR	95% ci.
Chronic dry cough		6.5	2.0-20.5
Tenure (months)	13-120	4.2	1.1-16.7
	121+	1.9	0.4-10.5
Grand mean		0.1	0.01-0.2

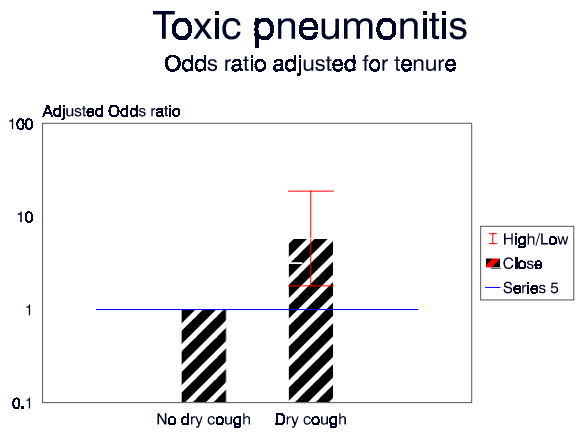

Figure 1
Odds ratio for toxic pneumonitis according to the presence of chronic dry cough adjusted for tenure